Robert L Bates

Journal of Geological Education

Volume 6 - Number 2

Fall 1958

Published semiannually by
THE ASSOCIATION OF GEOLOGY TEACHERS

CONTENTS

Bread and Butter Courses May Be Fattening.....*Arthur A. Socolow* 1

Physical Geology Integrated With
General Chemistry .....*F. Donald Eckelmann* 3

Geology in a Basic College Course .....*Richard J. Seltin* 6

Bioplastic Crystal Models .....*C. G. Winder* 9

Headaches From Igneous Rock Classifications.....*A. S. Wilkerson* 13

Motion Pictures for Geology Teaching, Part 2.....*Hall Taylor* 18

The Geologist in an Oil Company .....*F. Goldstone* 22

Book Reviews

L. Don Leet and Sheldon Judson: Physical Geology....*Sidney E. White* 28

Mark W. Pangborn, Jr.: Earth for the Layman..*Richmond L. Bronaugh* 28

Samuel P. Ellison, Jr.: General Geology Laboratory
Workbook .....*Malcolm P. Weiss* 29

James F. L. Connell: A Workbook for Invertebrate
Paleontology .....*Ralph H. Bond* 29

Transactions of the Association of Geology Teachers..... 31

The JOURNAL OF GEOLOGICAL EDUCATION is published
by the Association of Geology Teachers semiannually in the spring and fall,
at the Heer Printing Company, Columbus, Ohio.
Single issues: $1.25 for Vol. 2, No. 1 and later issues; $1.00 for
Vol. 1, Nos. 1-6

Address all communications regarding subscriptions, orders for single issues and
back issues, changes of address, etc. to the national treasurer of AGT:
James C. Brice, Department of Geology
Washington University, St. Louis, Missouri
Submit all manuscript to the editor:
Mildred F. Marple, Department of Geology
The Ohio State University, Columbus 10, Ohio

Journal of Geological Education

Volume 6 Fall 1958 Number 2

JOURNAL OF GEOLOGICAL EDUCATION
Vol. 6, No. 2, Fall 1958. pp. 1 - 2

BREAD AND BUTTER COURSES MAY BE FATTENING

ARTHUR A. SOCOLOW
University of Massachusetts

ABSTRACT. The function and presentation of the elementary geology course should be reexamined if that course is to survive in the face of programs of general education and general science. Rather than function as a well populated, money making course elementary geology should serve to demonstrate that geology is a dynamic science with widespread intellectual stimulus and application. The success of the course depends on the instructor who must be able to transmit with enthusiasm the stimulating experience which is geology. Great care should be exercised in selecting the instructor for the important course of elementary geology.

Geology teachers have long been concerned with curricular matters and teaching philosophies. Such topics as more or less applied geology, more or less required humanities, a 4 or 5 year curriculum, all have been aired—but not resolved.

A matter which merits increased attention and thought is the philosophy behind the elementary geology course—the one which is populated chiefly by non-geology majors who are required to take some science. Too often a rather calloused attitude prevails concerning this course in the curriculum. Because the tuitional fees from its large enrollments constitute the department's major source of income, it is called the "bread and butter" course. The departments zealously watch the enrollment figures and use them as levers for growth and improvement in the advanced courses dearer to the heart. A defensive resistance swells to the fore when any changes are suggested which threaten the enrollment upon which the department fattens. Such an attitude does harm not only to the students, but to the geology department as well in the long run. The greatest harm is that of lost opportunities to educate.

The fact is that a changing educational climate is developing around us—one which questions the traditional role of the sciences in the colleges and suggests that at least at the elementary level the sciences have not been doing the job of demonstrating their integral position in society or their intellecual contributions. Even textbooks have evolved into mechanistic assemblages attempting to depict cold, methodical science; periodically they are modernized with niftier pictures.

It is little wonder that there is a movement to such programs as general education in science and general science. Sooner or later it appears that every geology department is faced with this trend. Rather than fight it, it would be well

to indulge in self examination of the purposes and philosophies behind our elementary courses. Unfortunately, when pleas such as this are made, the instinctive reaction is, "My philosophy is all right; he must be talking about some other department." Too often complacency persists until suddenly the administration suggests a major change.

Elementary geology need not be doomed to be swept away or engulfed by general education or general science. Geology is a wonderful, dynamic subject which embraces all the physical sciences as well as some of the biological sciences; properly taught it can well serve the aims of general science education. Beginning geology can and should be a wonderful experience with value for any student. It must be presented as an intellectual experience with challenges of interpretation and observation. To accomplish this desirable goal there is no magic formula or a prescribed organization of material. It is not a matter of one textbook or another, one laboratory manual or another, or how many hours a week are involved.

The vital factor in the success of the beginning geology course is the instructor. If he is to transmit the dynamic spirit and intellectual significance of geology, he must himself be imbued with the spirit and have an intellectual capacity. The instructor must be able to convey that geology is alive, not merely that processes are going on, but that it is part of our lives, part of our society, part of our natural habitat and of our economic processes. The qualities for good instruction are not always present in the specialists or the researchers in whom the department takes pride. Careful selection is most important of the instructor who in one school year or less must be able to infect students, heading for many walks of life, with the inspiration of geology.

It is to be hoped that there will be more and continuing soul-searching about the elementary course in geology. By improving and keeping the course dynamic it can be a great contribution to all who take it, and it will survive. To resist or neglect change because it threatens the status quo is to invite change from outside pressures. It would be well to act now or else the "bread and butter" courses will no longer be fattening.

A GIFT FROM THE CENTRAL SECTION

At the eighteenth annual meeting of the Central Section the members authorized a contribution of one hundred dollars from the section treasury to the National Association to aid in defraying the expenses of printing the *Journal of Geological Education*. The editor here expresses the appreciation of all of the members of the Association for this generous gift which makes possible the publication of a larger and better *Journal*.

JOURNAL OF GEOLOGICAL EDUCATION
Vol. 6, No. 2, Fall 1958. pp. 3 - 5

PHYSICAL GEOLOGY INTEGRATED WITH GENERAL CHEMISTRY

F. DONALD ECKELMANN
Brown University

ABSTRACT. A physical geology course given at Brown University has a prerequisite of one semester of general chemistry or the equivalent. The sequence of chemistry-geology satisfies one of the science requirements of the undergraduate program, namely that each student pursue successfully a two semester course in one science, or two integrated courses in related sciences. An important advantage to geology is that general chemistry provides the necessary background for addition of new subject materials to physical geology and permits a physical-chemical approach to geologic phenomena previously handled in a largely descriptive manner. Thus topics dealing with atomic structure of minerals, phase equilibrium studies, and internal structure and composition of the earth are covered in this physical geology course. The prerequisite of general chemistry allows introduction of present day problems and trends in gelogic investigation to a greater extent than would otherwise be possible.

INTRODUCTION

In recent years physical science programs within the framework of liberal arts programs have experienced a gradual decrease in the number of students remaining in the sciences beyond the required introductory courses. This is primarily seen in the decreasing number of college students electing to concentrate in these fields. In colleges which only require a student to complete one year of any science, geology is often left without an opportunity to make contact with large numbers of good students, some of whom would be attracted to this area if the necessary introduction had been made. In addition, physical geology courses are often confronted with the problem of being attractive to large numbers of students faced with a science requirement but lacking the interest and ability to pursue courses requiring a background of elementary mathematics, chemistry and physics. Thus a substantial proportion of students in introductory geology come with the hope of being confronted by a less demanding science. Many students find their wish granted in introductory geology courses, and by their presence make it very difficult for such courses to reach much beyond the purely descriptive aspects of the subject. Consequently these courses do not include recent contributions from geochemistry, geophysics, experimental petrology, and the like. Long term effects automatically follow. The bulk of students attracted to a concentration in geology lack interest and aptitude in the related sciences, and in turn avoid even the introductory college courses in these fields, or at best do poorly in those courses required for graduation. The large graduate schools are closed to most students having this background, while the few who do manage to enter a good graduate program find large areas of research beyond their grasp.

Attempts to resolve the dilemma generally involve either including increased amounts of chemistry and physics in elementary geology courses or deleting the

geologic material requiring such a background. But both routes are disappointing at best. The first requires too much time to teach students the necessary chemistry and physics while the second causes important topics to be handled too briefly or omitted altogether. The first route provides neither an elementary chemistry course nor a good geology course while the second route results in a highly descriptive geology course. The geology student's serious lack of interest and ability in the related sciences is the major reason for the continued existence of this dilemma. Therefore, the success of a rigorous up-to-date physical geology course appears to depend in a large part on obtaining students with proven aptitude in the related sciences as well as a genuine interest in geology. The student meeting these qualifications will be sufficiently mature to hold his own both in class and in reading assignments covering areas that are completely new to him. The problem then is one of attracting the qualified student to a geology course which builds on the base provided by a general chemistry course.

AN INTEGRATED CHEMISTRY-GEOLOGY PROGRAM

The task of attracting talented students to the sciences is resolved in part at Brown University by the following requirements: 1) all students must successfully pursue four semester courses in the sciences, 2) two of the courses must form a year sequence (to develop depth in one area), and 3) one of the four courses must be in chemistry, physics or mathematics. One benefit derived from such an arrangement is the opportunity to introduce fearful, reluctant students to areas of science for which they actually have dormant ability and interest. Secondly, less publicized sciences (e.g., geology) have increased opportunity to make contact with promising students early in their college training.

The chemistry-geology course is an approved year sequence with the geology portion offered after completion of one semester of general chemistry. Each half of the sequence carries four semester hours of credit. In geology this is divided into three lecture hours and one laboratory period of three hours. Over the past several years enrollment in the chemistry half has grown to around 140 students, of whom 20-25% end up in the D or E (failure) bracket. A failing grade bars a student from continuing while very few of the students receiving D elect to continue in geology. The enrollment in geology usually is 55-60% of the group having done C or higher quality work. These students have a good working knowledge of elementary chemical principles; are not fearful of topics dealing with silicate structures, radioactivity, etc.; and are capable of independent study along similar lines by way of reading assignments. The chemistry prerequisite serves also to eliminate the poor students from the second half of the course.

The course material in the second semester differs from many physical geology programs in both emphasis and content. Topics such as lakes, swamps, streams, erosion, and land forms are handled briefly in class. Outside reading (or material in the text) serves as a supplement, while those students intending to concentrate in geology are held responsible for obtaining, on their own, a more complete acquaintance with these subjects prior to senior comprehensive exams. Much

of the new material in the course comes at the outset. An extended period of time is spent covering the origin of the universe, solar system, and the earth, for the purpose of understanding the place of the earth in the universe; the contrast in chemical composition between the earth, larger planets, suns, and the universe as a whole; and the gross internal structure of the earth plus the compositional contrasts between crust, mantle, and core. The last point is developed along with a consideration of seismic studies. This is followed by lectures dealing with methods of absolute age determination (developing the uranium-lead method in particular) and development of the geologic time scale. Minerals are then studied with reference to types of bonding, coordination numbers and common silicate structures as a function of energy in a cooling magma. Prior to lectures dealing with rocks and minerals the class has been acquainted with the common rock forming and ore forming minerals in the laboratory. This serves as a background for study of the nature and origin of sedimentary, volcanic and plutonic rocks in both lecture and laboratory sessions. The latter part of the course deals with the hydrosphere, atmosphere, weathering, erosion, glaciers and deserts. Throughout, emphasis is placed on the physical-chemical principles related to phenomena observed in the field. Both emphasis and subject material serve to attract the more versatile science student to a geology concentration. The textbook in use at present is *Physical Geology*, by L. D. Leet and S. Judson.

CONCLUSIONS

The program discussed above has several clear advantages:

1) An opportunity is provided to present highly significant recent results from geochemical and geophysical research to students in physical geology.

2) A geology department has the opportunity to make contact with an increased number of students who have proven abilities and training in the related sciences, rather than having contact primarily with students who have fearfully (and sometimes rather successfully) avoided such disciplines.

3) Geology majors derived from such a course should be more able to prepare themselves in the related sciences, for graduate studies and for participation in the present trend of geologic, geochemical and geophysical research.

Some will object to such an extensive revision of subject material in physical geology on the grounds that important topics are omitted or handled too briefly. The author agrees that present day geology students should cover most of the material contained in the best physical geology texts of a decade ago. However, much of this can be obtained by the student on his own during his undergraduate days. In this way lecture hours are made available for consideration of more recent geologic investigations.

ACKNOWLEDGEMENTS

The integrated course sequence described in this article was initiated at Brown University several years ago by Professor A. W. Quinn, Chairman of the Department of Geology. The author has had the pleasure of taking part in this program during the past year.

JOURNAL OF GEOLOGICAL EDUCATION
Vol. 6, No. 2, Fall 1958. pp. 6-8

GEOLOGY IN A BASIC COLLEGE COURSE

RICHARD J. SELTIN
Michigan State University

ABSTRACT. All freshmen entering Michigan State University are required to take a three quarter Basic College course in Natural Science. Several weeks of the second quarter of this course are spent in exposing the student to geology. Here he studies minerals and rocks, the development and interpretation of land features, and considers some of the important theories in geology. The LIFE magazine "World We Live In" series is discussed in relation to this course and possible application to other introductory geology courses.

During the first two years of a student's education at Michigan State University he is a student of the Basic College and is required to take four one-year courses. These four courses are Communication Skills, Social Science, Humanities and Natural Science.

In the Natural Science course four objectives are used as a basis for teaching the student about science. The first objective is simply to give the student an understanding of science. The other three objectives might be considered subheadings under this main objective. The second objective is to give the student a knowledge of some of the subject matter without attempting to survey science. The third objective is to teach the student some of the "methods" of science. The fourth, and last, objective is to show the relationship between science and other fields, such as the social sciences, religion, etc.

A manual has been written by the staff members of the Natural Science Department for each quarter of the course. These manuals are so designed that the student is led to an understanding of the material in the laboratory and then reads about it. In the laboratory the student is led through a series of questions to examine several possible explanations for the same phenomenon. He is then led through the reasoning for accepting one explanation in preference to the others.

Geology is taught as part of the second quarter of the Natural Science course and is important to the sequence in at least two ways. First in introducing the student to the science of Geology and the world in which he lives and the causes of the present structure of the face of the earth. Secondly, the geology section of the course is a natural and important background to the Theory of Evolution, which follows.

The first week's work deals with minerals and the second week's with rocks. In these studies the student sees the development of two contrasting types of classification systems: an empirical system (minerals) and a deductive system (rocks). He also learns the names and how to identify many common minerals and rocks and of the origin of rocks.

Drawings from the LIFE magazine series "The World We Live In" are used in the third laboratory to introduce the student to the elevating and leveling processes which change the form of the earth's surface. With these excellent drawings, the average student can easily picture the results of volcanism, diastrophism and gradation. In the first picture ("The Land: How Mountains are Born") mountains resulting from folding, faulting and volcanics are shown. The student is led through a series of questions in which he interprets the origin of these various mountain types. Using the second drawing which represents the same area after erosion, the student is asked to interpret the effects of stream, glacial, wave and underground water erosion on the area.

Meanwhile, in the textual material, and with the laboratory work as a background, the student considers two sets of geological theories. The first set is neptunism versus plutonism, and the second set is catastrophism versus unformitarianism. The student should be able to make up his own mind as to the correct theory of each set.

In the fourth, and last, laboratory exercise in geology the student uses his knowledge from the previous exercises to interpret two land features. The first of these is represented by a photograph of Sheep Mountain, Wyoming (from the LIFE "World We Live In" series). The questions lead the student to try other types of mountain development before he realizes that Sheep Mountain is an eroded anticline. In the second part of the exercise the student is given eight drawings representing stages in the development of Grand Canyon. He must put these in chronological order and interpret the history of the Canyon.

It seems worthwhile to make a few comments on the LIFE magazine "World We Live In" series and its potential for use in introductory geology courses. We feel that these drawings have been used to great advantage in the Natural Science course where the size of the class (two thousand or more students) prohibits field study.

Field study of geological features is always to be preferred, but many factors prevent introductory students from being taken into the field. Some of these factors are: very large classes, expense, accessibility of features, lack of features which would warrant the expenditure, etc.

The LIFE series can fill this need no matter what the size of the class or how little money is available. Even if field trips are taken these pictures can supplement the trips both in showing how the available features develop and in showing features not available on the trips (e.g., mountains if the trips are made in the middle West).

The pictures are not alone a cure for lack of field work, but must be carefully incorporated into the laboratory work. Exercises can be built around them. For example, in the Sheep Mountain exercise the student is not simply told that this is an eroded anticline. He must consider all types of origin and must draw simple diagrams to show the origin by folding and erosion.

We feel that all lay students graduating from Michigan State University have had a fairly satisfactory exposure to geology in the Basic College Natural Science course. The student has an idea of the history of the small planet on which he lives and should appreciate the purposes of geology. He understands better the origin and the time involved in the formation of land features. He has an idea of how the geologist works and is better adapted to interpret statements made in regard to geology.

Our course is far from perfect, but we are constantly striving to improve it. The members of the Natural Science Department are now working on an extensive revision of the entire course. Perhaps, however, some other college or university contemplating a similar use of these materials may find our system fruitful.

NEIL MINER AWARD 1958
to
CHARLES HENRY BEHRE, JR.

The Neil Miner Award for 1958 will be presented at the Annual Meeting to Dr. Charles Henry Behre, Jr., Professor of Geology at Columbia University.

Dr. Behre has enjoyed a successful career in teaching since he received his doctor's degree at the University of Chicago in 1925, holding posts at Lehigh University, the University of Cincinnati, and Northwestern University before going to Columbia in 1941. He is a member of many professional societies and is widely known as a consulting geologist in the fields of ore deposition and mineral economics.

He is known as a teacher for his unusually conscientious dedication to his students. He has earned the reputation of never being too busy to advise students in their academic and personal problems. Those who have studied under him have nothing but the greatest enthusiasm and admiration, for he inspires his students as do few teachers. His wealth of practical knowledge in economic geology is based on first hand information making his lectures refreshing and far from the stereotyped presentation of some whose dependence on textbooks is so necessary.

Dr. Behre is a charter member of AGT in what is now the Central Section and he has always been a staunch supporter of our cause. In his active participation in the affairs of the organization, he has contributed certainly as much, and possibly more, than any other individual. The Association of Geology Teachers honors itself in honoring Dr. Behre.

JOURNAL OF GEOLOGICAL EDUCATION
Vol. 6, No. 2, Fall 1958. pp. 9 - 12

BIOPLASTIC CRYSTAL MODELS

C. G. WINDER
The University of Western Ontario

ABSTRACT. Crystal models made of bioplastic with balsa wood axes have been found satisfactory for introducing crystallography to elementary geology students. The models are fairly durable and inexpensive.

The problem of introducing crystallography to elementary geology students has long been hampered by the general lack of large durable teaching models. Crystals made of celluloid and similar materials have been found to be much too fragile for examination by several hundred students; opaque models made of wood and aluminum do not display axes of reference necessary to explain the symmetry of a crystal. Orthographic projections are virtually useless for a student who has not acquired three-dimensional visualization.

Crystal models of bioplastic with embedded axes of reference made of balsa wood have been found satisfactory for introducing the student to crystallography. The models are sufficiently durable that continuous handling does no harm; surfaces which may become scratched can be buffed smooth once a year. The following materials are sufficient to make one basic crystal with an average maximum dimension of three inches for the isometric, hexagonal, tetragonal, orthorhombic, monoclinic and triclinic systems.

1. Three quarts of Bioplastic with ½ ounce of organic catalyst.
2. About five feet of 2 mm. square balsa wood sticks.
3. Eight square feet of cardboard laminated on one side with aluminum foil.
4. Rubber cement and brown gummed paper.
5. Small box about 6″ x 6″ x 6″ partially filled with sand.

The construction of the isometric mold consists of drawing on the cardboard a three inch square which will be the basal pinacoid of the model; increasing or decreasing the size of this square will result in a corresponding larger or smaller crystal. Along each edge of the square draw a rectangle, 3¼ inches in length which when folded up will be a prism face. Along one, and the same edge of each side draw a triangular flap which can be folded over and glued to the adjacent prism face when the sides are turned up. Along each drawn line, score the cardboard to facilitate folding and then cut out the form leaving the triangular area on the sides for gluing purposes. In figures 1 and 2, the basic outline for the monoclinic and triclinic forms are shown with cut lines solid and scored lines dotted. When the sides are then turned up with the aluminum foil on the inside,

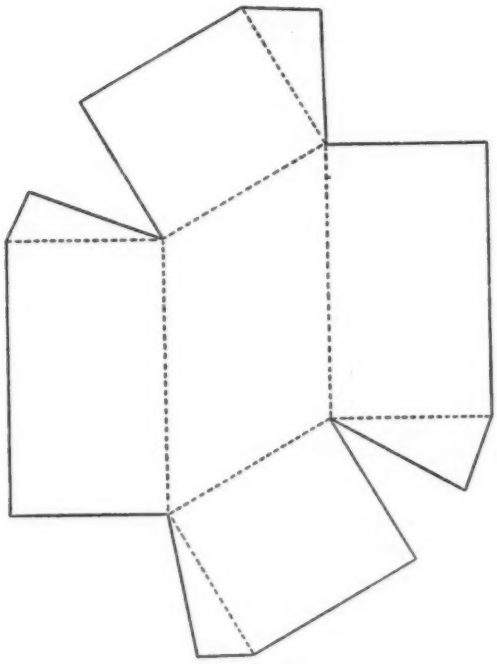

FIGURE 1: Outline of form for the monoclinic crystal. Note the overlapping flaps along the sides of prism faces.

the flaps can be folded over adjacent sides and temporarily held with rubber cement and/or a staple at the upper edge. When all sides are in place, each edge should be secured with heavy brown gum paper to prevent leakage of the bioplastic. The resultant isometric mold is an open-topped box, with a three inch square base and 3¼ inch sides.

The other molds are constructed in a similar manner with the following approximate dimensions:

Hexagonal—the hexagonal base is 2½ inches across; the rectangular sides along each edge of the hexagon are 4½ inches in length.

Tetragonal—the base is a 2¾ inch square with attached sides on each edge of 4¼ inches in length.

Orthorhombic—the base is 2½ x 3 inches with attached sides on each edge of 4¼ inches in length.

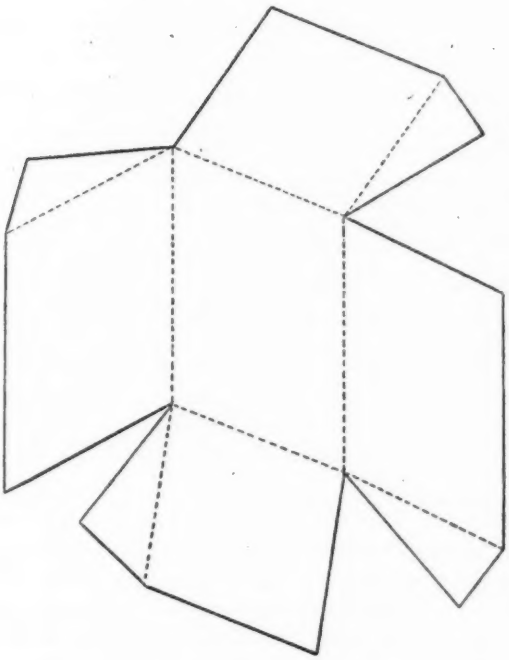

FIGURE 2: Outline of form for the triclinic crystal.

The scale outlines for the monoclinic and triclinic molds are shown in figures 1 and 2; note in each case the triangular flaps which are left along each prism face for gluing to the adjacent face.

Balsa wood is suggested for the axes of reference, because construction is easy and the wood can be coloured. String and wire were considered but a poor axes junction at the center of the crystal might result. Another consideration was drilling fine holes after the crystal had solidified and injecting coloured plastic; the thought of not having the drill holes meet at the center discouraged an attempt.

The balsa sticks are cut in lengths corresponding with the length of the pinacoid and prism faces. Two axes are notched at the middle and glued with extra fast drying model cement. The shorter axes are cut in two and glued in the correct position in relation to the first two axes for the particular crystal model. The length of the horizontal axes for the hexagonal crystal depends upon whether first or second order prisms are desired. The axes for the monoclinic and triclinic axes should not be constructed until after the mold has been com-

pleted as the angles between axes can be measured from the corners of the mold. The axes can be coloured and then coated with acrylic spray to prevent running.

If the axes are constructed carefully, they can be placed in the mold with the ends of the horizontal axes just touching the center of the prism and basal pinacoid faces. With the monoclinic and triclinic forms, it may be necessary to hold the axes in place with fine dissecting pins inserted through the cardboard. Insertion of the axes in the model is facilitated if the upper end of the axis protruding from the top of the mold is left a little longer.

The completed mold with inserted axis is then placed in the six-inch box and fine sand is poured in around the mold to support the sides. The mold is filled with bioplastic, adding at the same time 12 to 15 drops of organic catalyst. A thin glass rod worked through the liquid, but avoiding the axes, mixes the ingredients. Air bubbles trapped in the bioplastic usually will rise to the top before hardening occurs. In about four days, the aluminum-faced cardboard can be stripped off leaving plane clear surfaces. The upper surface of the crystal may be irregular but, along with other imperfections, can be smoothed by cutting on a diamond saw and polishing on a buffing wheel.

Although the models may not be absolutely correct for symmetry or position of the axes, the elementary student does not usually concern himself with small imperfections. Two disadvantages for bioplastic models are the brittleness of the material which results in cracks if the model is dropped, and a high index of refraction which gives the illusion of two sets of axes within the model when viewed from an angle. However, the first can be remedied by further grinding; if chips are knocked off, they can be replaced with plastic glue. The second can be readily explained to the student.

The materials for a set of crystal models of the size described herein would cost less than $15.00. The time spent in constructing the models is saved in the length of explanations during the introduction of crystallography to elementary students.

JOURNAL OF GEOLOGICAL EDUCATION
Vol. 6, No. 2, Fall 1958. pp. 13 - 17

HEADACHES FROM IGNEOUS ROCK CLASSIFICATIONS

A. S. WILKERSON
Rutgers, The State University of New Jersey

ABSTRACT. Students in a beginning class in petrography made Rosiwell analyses of an igneous rock, using sixteen thin sections made from contiguous slices. Each student examined only one thin section. It was found from this study that two different numbers in Johannsen's system of classification could be employed in describing the specimen. The author then made a more thorough study, using all of the slides and making twenty, instead of the customary ten, equally spaced traverses across each side. Again, two different Johannsen numbers could be applied, but these were not in every case the same numbers as those obtained from the students' analyses. When the mineral percentages were expressed to the nearest tenth, the rock could be classified under one of Johannsen's numbers, but when the percentages were considered as whole numbers a different rock name could be applied. Comparison was then made with the classification systems of Winchell, Iddings and Shand. The students soon learned that no system of rock classification is entirely satisfactory.

The undergraduate student who takes a course in elementary petrography has been told that there are perhaps a thousand names in use for different types of igneous and pseudo-igneous rocks. Before he classifies his first rock based on thin section data, he is made aware of the history of the development of the relationship of volume-area-lines-points used for modal analyses. He has had his attention called to the several rock classifications based on the norm and the mode, and he is aware of the fact that some classifications are qualitative while others are quantitative in nature. Knowing that rock types grade into one another, he is aware that pigeonhole classifications are often misleading with their clear-cut boundaries. But it is only after the beginning student in petrography actually uses different classifications that he appreciates their inadequacies and differences. For his first thin section he has confidence in his ability to determine the rock-forming minerals and has unshaken faith in his ability to use the recording micrometer, and thus the student eagerly seeks the name of his rock.

Frequently the instructor of a petrography class has incidents arise that shake his faith in Rosiwal analyses as being representative of the thin section as a whole, and emphasize his displeasure with existing rock classifications. Being in need of thin sections of nepheline syenite for class study and for comparison with slides of nepheline syenite of local occurrence at Beemerville, New Jersey, the writer years ago had 16 thin sections made from an unlabled hand specimen. For detailed petrographic reports of the rocks, the students made Rosiwal analyses of the Beemerville rock and of the syenite from the unknown locality. The class was divided in its opinion as to the correct classification of the rock from the unknown locality when Johannsen's classification was used. Some reported it was 2121, others insisted on 3121. Each student studied only one unstained thin section. The writer, using two thin sections, had previously determined the rock to be 3121, the leucocratic minerals comprising 45 per cent and 48 per cent of

the mineral assemblage. Students the next year again differed as to Johannsen's number, this time a few slides that previously had been numbered 3121 were reported as 2121, and vice versa. It was not until a year or so later that the writer found time to study each of the 16 slides, these having been made from contiguous slices, but in what order they were numbered is not known.

The students had run ten approximately equally-spaced traverses across the slides, using a Hunt-Wentworth recording micrometer with five micrometer heads. Ten traverses were made because of Wentworth's original suggestion that 8 to 10 traverses are to be taken across a slide at intervals of about one millimeter and because of the statement to this effect in the directions that accompany each new recording micrometer. One slide was used because this was the number available to each student in a class of 16 and because most of us use as few thin sections as possible in analyzing a hand specimen. In fact, the majority of modal analyses is based on only one thin section.

The writer decided to make 20 approximately equally-spaced traverses across each of the 16 slides because he realized that the mineral percentages differed with the location of the traverse. The 20 traverses were treated as three separate analyses; traverses of the 10 odd numbers, traverses of the 10 even numbers, and the 20 traverses as an average. Thus for each slide the rock can be thought of as having been analyzed three times. Further, in calculating the percentage composition of the minerals, the writer decided to keep the percentages to the nearest calculated tenth of a percent on the one hand, as is sometimes done, and on the other hand to record the percentages in whole numbers only, as is likewise sometimes done. Percentages of accessory minerals less than one-half percent were recorded as a trace. For each slide six, rather than three, different percentages were calculated. The writer also used different rock classifications for each of the slides, as did the students. Unexpected results were obtained.

Megascopically, the rock is medium to dark brown-gray in color and is composed of medium size grains of brown nepheline, colorless feldspar, black pyroxene, and biotite.

Under the miscroscope the rock is hypautomorphic-granular. It is composed of orthoclase feldspar, nepheline, augite, aegyrine, and biotite. Accessories are apatite, sphene, magnetite, fluorite, and zircon.

The outline of orthoclase, generally untwinned, is allotriomorphic. The size seldom exceeds 3.5 mm. x 2.5 mm. and the average size is about 1.5 mm. x 1.2 mm. Some crystals contain inclusions of apatite, aegyrine, and nepheline. Local alteration to clay substances, a colorless mica, calcite, and cancrinite is observed.

Most nepheline crystals are subhedral but some are euhedral. A maximum size of 3.5 mm. x 3.3 mm. occurs, with an average size of about 1.3 mm. square. Inclusions of aegyrine and apatite are seen. Nepheline is partly altered to cancrinite, a colorless mica, and calcite.

Colorless, usually untwinned, euhedral and subhedral augite crystals average 1.5 mm. x 1.0 mm. in size, but some are 7.2 mm. x 1.3 mm. Most crystals have narrow rims of aegyrine. Some crystals with their reaction rims are partially replaced by biotite.

Yellowish-green to green aegyrine normally occurs as rims on augite, but some euhedral crystals up to 5.6 mm. x 1.0 mm. in size are present.

Biotite is light tan or yellowish to deep reddish-brown in pleochroism, and is locally altered to magnetite. The average size is 1.0 mm. x 0.8 mm., with the largest seen being 4.6 mm. x 1.3 mm.

Apatite occurs in prisms up to 2.0 mm. long. Magnetite, frequently altered to red iron-oxides, is both primary and secondary, and seldom exceeds 0.3 mm. square. Wedges of sphene attain 2.2 mm. x 1.0 mm. in size and locally are slightly altered to leucoxene (?). Fluorite has a purple tint.

The slides are ideal for student study, but at numerous places the feldspar and feldspathoid are intergrown so that the recorded percentages of these minerals taken separately, but not the combined percentages, may be questioned as to their exactness.

The percentage variations of the minerals are presented in Table 1. Table 2 summarizes the number of thin sections that can be classified as belonging to Johannsen's numbers 2121 and 3121 for the 10 odd numbered traverses, 10 even numbered traverses, and the 20 traverses, where the data are for mineral percentages to a tenth of a per cent and also where the percentages are in whole numbers.

TABLE 1

PERCENTAGE VARIATIONS OF MINERALS IN 16 SECTIONS

ORTHOCLASE	3	TO	22
NEPHELINE	23	TO	41
AUGITE	22	TO	41
AEGYRINE	4	TO	11
BIOTITE	6	TO	17
APATITE	2	TO	6
MAGNETITE	1	TO	5
SPHENE	tr	TO	2
LEUCOCRATS	40	TO	61
RATIO OF ORTHOCLASE TO FOIDS	7	TO	45

TABLE 2

CLASSIFICATION OF THIN SECTIONS ACCORDING TO JOHANNSEN

	2121	3121
10 ODD NUMBERED TRAVERSES		
To tenth of a percent	9	7
Whole numbers	8	8
10 EVEN NUMBERED TRAVERSES		
To tenth of a percent	7	9
Whole numbers	7	9
20 TRAVERSES		
To tenth of a percent	7	9
Whole numbers	7	9

Table 2 indicates that the classification of the rock, according to strict adherence to Johannsen's definitions of class, order, and family, depends upon the locations of the traverses and the number of traverses. For one slide, using 10 traverses, the classification depends upon whether one keeps a decimal or changes the percentages to whole numbers. In this one case 50.7 per cent total leucocrats were present. It can be questioned if 50.7 per cent total leucocrats should be considered as greater than 50 per cent as demanded by Johannsen for inclusion in his class number 2. The writer can see no valid reason why it should not be considered greater. The correctness of the mineral analysis can be logically questioned, but it is as reasonable to assume that the percentage of the leucocrats is too small as it is to assume that it is slightly too great.

From Table 3 it is seen that, if the percentages of the minerals of the 16 thin sections are recorded to a tenth of a percent, the rock belongs to Johannsen's

number 3121. It also shows that the rock belongs to number 2121, if the percentages are kept as whole numbers. Which is the correct procedure, and exactly why? The writer sees no valid reason for the use of whole numbers when actually one's calculated results usually indicate a fraction. It is not egotism that allows one to keep a fraction of a percent in his analysis. Every petrographer and beginning student of petrography knows that he really is not recording true values but that they are educated estimates. Even so, the writer cannot agree with Chayes (1956, p. 47) when he states that "—it does not matter that no two analysts get exactly the same result for any particular slide". This is true, if one desires a modal analysis from a thin section but realizes that the analysis obtained is not that of the thin section, the hand specimen, the outcrop, or the massif represented by the thin section. It may not be true, however, when one must classify a rock from only one thin section. It may likewise depend upon the classification used.

TABLE 3

AVERAGED MINERAL PERCENTAGE OF 16 THIN SECTIONS

	A		B		C	
ORTHOCLASE	14.1	14	13.9	14	14.0	14
NEPHELINE	32.5	33	32.3	32	32.4	33
AUGITE	27.9	28	28.1	28	28.0	28
AEGYRINE	7.6	8	7.4	8	7.5	8
BIOTITE	10.2	10	10.9	11	10.6	11
APATITE	3.7	4	3.5	4	3.6	4
MAGNETITE	3.1	3	2.9	3	3.1	3
SPHENE	0.5	1	0.6	1	0.5	1
ZIRCON	tr	tr	tr	tr	tr	tr
FLUORITE	tr	tr	tr	tr	tr	tr
SUM	99.6	101	99.6	102	99.7	102
LEUCOCRATS	50.3	51	49.7	51	50.0	51
RATIO OF ORTHOCLASE TO FOIDS	30.3	29.8	30.1	29.8	30.2	29.8
JOHANNSEN'S ROCK NUMBER	3121	2121	3121	2121	3121	2121

A 10 odd numbered traverses
B 10 even numbered traverses
C 20 traverses or average of A and B

The students used four different rock classifications. When the rock was classified, according to Johannsen, (1938, pp. 247,248) as 2121P it apparently is nordsjoite (nepheline-rich juvite), but it cannot be this because the description of nordsjoite is not that of the rock under consideration. Classified as 2121H, it apparently is muniongite or sussexite. The former has no nepheline, or if present, the rock has a hyalopilitic texture; the latter, or sussexite, has a tinguaitic groundmass.

When the rock was classified as 3121P, it apparently is fasinite or eleolite-mica syenite (Williams) (1891, pp. 185, 208-227) or biotite-ijolite (Washington) (1900, p. 400), but the descriptions are not those of the unknown rock. Classified

as 3121H, either tjosite or damkjernite apparently is the name, but the descriptions (Johannsen, 1938, pp. 277, 278) are not applicable. Confusion resulted.

Using Winchell's classification, (Winchell, 1913, pp. 208-244) the rock is nepheline syenite.

Iddings' classification was then consulted. (Iddings, 1913, I, p. 387, II, p. 245) Approximately a dozen rock names were eliminated because they contain "little" (not defined) ferromagnesian minerals. Of those possibilities that contain "much" (not defined) ferromagnesian minerals, two rocks are possibilities, i.e. nepheline-malignite and ijolite. Some of the thin sections could be classified as nepheline-malignite or nepheline-pyroxene-malignite, but augite is not recorded by Iddings as being present. Some thin sections possibly could be named ijolite, but biotite is not recorded as a mineral constituent of this rock. Giving two names to one rock, however, helped to confuse the student. This was especially true because neither name was entirely satisfactory.

Shand (1943, p. 395) probably would classify the rock as a mesotype syenoid or malignite.

Perhaps, as has been suggested by a few facetious students, the name of the rock should be 2.5 121—nepheline syenite—ijolite—malignite. This would be better than if the advice of a few advocates of returning to the language of babyhood were accepted, i.e. to coin words by putting together unrelated syllables such as olpybinemelite for an olivine—pyroxene—biotite—nepheline—melilite rock. (Shand, 1943, p. 205)

It is only after the beginning student has actually used various igneous rock classifications that he fully realizes their inadequacies, that at present he must be content when he assigns a name to a rock, and that he should state the classification he used. He at last realizes that a diorite of one author, for example, may be a gabbro of another. The student soon learns that the recommended 10 traverses per thin section frequently is too small a number. He is convinced that one thin section is not in all instances representative of the hand specimen from which it was made. The writer's students believe that percentages should be kept to the calculated tenth of a percent.

As a teacher of petrography, the writer would like to ascertain how his follow-petrographers would have their beginning students classify said rock, and why. The answer certainly does not lie in using more or newer classifications.

Chayes, F.: *Petrographic Modal Analysis,* John Wiley & Sons, Inc., New York, 1956.

Iddings, J. P.: *Igneous Rocks,* John Wiley & Sons, Inc., New York, 1913.

Johannsen, A.: *Petrography,* Vol. 4, The University of Chicago Press, Chicago, 1938.

Shand, S. J.: *Eruptive Rocks,* John Wiley & Sons, Inc., New York, 1943.

Washington, H. S.: *Igneous Complex of Magnet Cove, Arkansas,* Bull. Geol. Soc. Amer. Vol. 11, 1900.

Williams, J. Francis.: *The Igneous Rocks of Arkansas,* An. Rept. Geol. Surv. Ark. for 1890 (1891), II.

Winchell, A. N.: *Rock Classification on Three Co-ordinates,* Jour. Geol., Vol. 21, No. 3, 1913.

JOURNAL OF GEOLOGICAL EDUCATION
Vol. 6, No. 2, Fall 1958. pp. 18 - 21

MOTION PICTURES FOR GEOLOGIC TEACHING

HALL TAYLOR
Columbia University

Part 2

Continued from Spring issue

CONTINENTAL GLACIERS. 16 mm. Sound. Color. 13 minutes. 1955.

Résumé. Produced at Ohio State University from films shot in Greenland by Dr. R. P. Goldthwait, this picture shows modern glaciers at work, forming many of the characteristic physiographic features which are their calling cards.

Audience suitability. For classes in physical and glacial geology.

Distributor. For preview or purchase ($130) write the Dep't. of Photography, Ohio State Univ., Columbus 10, Ohio.

EARTHQUAKES. 16 mm. Sound. B. and W. 10 minutes. 1953.

Résumé. After an introduction with scenes taken at the sites of severe quakes (Messina in 1908, China in 1920, Tokyo in 1923), this film tells, with John Kieran narrating, something about the different types of earthquake waves, and how seismologists record and use them to pinpoint the source of earth tremors and their causes. It ends with a brief look at the major earthquake belts of the world.

Audience suitability. Elementary in its approach—the explanation of faults is grade school level—but useful even for many college-age physical geology students who have progressed through some of our modern schools.

Distributor. Preview, rental and sale ($50) is handled by Almanac Films, Inc., 516 Fifth Ave., New York 36, New York.

EARTH'S SKIN. 16 mm. Sound. B. and W. 9 minutes.

Résumé. After looking first at some areas of the earth's crust where the rocks are extensively folded, this film, produced at Kent State University, briefly surveys the passage of geologic time, the emergence and disappearance of some prehistoric animals, and finally the advent of Pleistocene ice sheets. A return of the ice in 100,000 years is predicted!

Audience suitability. For those beginning the study of historical geology.

Distributor. For preview, rental or purchase ($50) write Almanac Films, Inc., 516 Fifth Ave., New York 36, New York.

FERNS. 16 mm. Sound. B. and W. 12 minutes. 1950.

Résumé. Edited and narrated by John Kieran, this old but useful film outlines the paleontologic record of ferns from their early emergence as land plants more than 300 million years ago, to their present profusion over much of the globe. Outstanding time-lapse photomicrography shows the role of antheridia, archegonia, prothallia, etc. in reproduction among these spore-bearing plants.

Audience suitability. For classes in historical geology and paleobotany.

Distributor. To preview, rent or purchase ($50) this film write Almanac Films, Inc., 516 Fifth Ave., New York 36, New York.

MAKE NO MISTAKE. 16 mm. Sound. Color. 23 minutes.

Résumé. This is a "safety" film, intended originally for training new employees on seismic shooting crews. It explains the hazards of seismic exploration work in arid regions such as western Texas, swampy lowlands such as southern Louisiana, and deep water such as the Gulf of Mexico.

Audience suitability. For classes in geologic field methods.

Distributor. Public Relations Dep't., Geophysical Service, Inc., 5900 Lemmon Avenue, Dallas 9, Texas.

MIRACLE OF MOSS. 16 mm. Sound. B. and W. 9 minutes. 1952.

Résumé. Narrator John Kieran, with the aid of both macro- and microphotography, describes a few of the world's many varieties of mosses, noting their complex internal structures, and manner of reproduction.

Audience suitability. For students of ecology, historical geology, and paleobotany.

Distributor. For preview, rental or purchase ($50) write Almanac Films, Inc., 516 Fifth Ave., New York 36, New York.

PETROLEUM AND ITS USES. 16 mm. Sound. B. and W. 40 minutes.

Résumé. The U. S. Bureau of Mines and the Sinclair Refining Co. cooperated to produce this picture which shows the drilling of a modern oil well, the construction of a pipeline, and then the production of some of the hundreds of products derived from petroleum, including sprays, explosives, cosmetics, anesthetics, fabrics, paints, plastics, fuels, and lubricants.

Audience suitability. For any class studying the economic importance of the oil industry.

Distributor. Graphic Services, U. S. Bureau of Mines, 4800 Forbes Street, Pittsburgh 13, Pa.

RECENT CARBONATE DEPOSITS IN THE FLORIDA KEYS. 16 mm. Sound. Color. 38 minutes. 1957.

Résumé. After examining a number of exposed fossil reefs, such as El Capitan in west Texas, this film moves to the Florida Keys and focuses on environments, mainly underwater, in which reef deposits are forming today. First is Tavernier Creek, noted for its sponges, then Mosquito Reef with its many corals and total lock of terrigenous sediments, then White Bank, on which six distinct ecologic zones are recognized and studied, after which come brief visits to Dry Rocks and Hen and Chickens Reefs. Strikingly contrasted in this picture are the ancient limestone reefs occurring in different parts of the geologic column, and the varied modern reefs forming in southern Florida today.

Audience suitability. Of particular interest to students of ecology, sedimentation and paleontology.

Distributor. Film Library, Socony Mobil Oil Co., Inc., 150 E. 42nd St., New York 17, N. Y.

RENDEZVOUS IN THE REEF. 16 mm. Sound. Color. 30 minutes.

Résumé. A husband-wife team, Wesley and Constance Mueller, spent 2,000 hours over a 10 year period gathering these underwater shots on the Bahama coral reefs. Good entertainment.

Audience suitability. For any teen-agers or adults, geologists or otherwise, contemplating underwater work. It deftly debunks ideas about unduly "dangerous" sharks, barracuda and moray eels (if conch meat is handy).

Distributor. Sales Dep't., Esso Standard Oil Co., Hutchinson River Parkway, Pelham, N. Y. (Loaned only in states where Esso products are sold).

RESEARCH — PATTERN FOR PROGRESS. 16 mm. Sound. Color. 22 minutes.

Résumé. Filmed primarily at Texas Co. research centers in Beacon, New York, Port Arthur, Texas and Montebello, California, this picture emphasizes the importance of research as it strives to improve operations and products in the oil industry. Only the first few minutes of the film consider geological aspects of the search for oil; much of the balance covers chemical and engineering research on production of both natural and synthetic hydrocarbons.

Audience suitability. A good supplement for discussions of research programs of major oil companies.

Distributors. Sales Department, The Texas Co., 205 E. 42nd St., New York 17, N. Y. (Also at division offices in about 14 other cities.)

ROLE OF CONCURRENT DEPOSITION AND DEFORMATION OF SEDIMENTS IN DEVELOPMENT OF SALT DOME GRABEN STRUCTURES. 16 mm. Sound. Color. 13 minutes.

Résumé. Though the title is long this film

is concise and informative. Sedimentary layers within a glass-sided model are subjected to deformation during deposition, and the resulting graben structures (which differ from those that might be expected under some conventional theories) are pictured as they form. An impressive way to demonstrate the effects of faulting, but the comparatively rapid film presentation should be preceded by an instructor's careful discussion of the subject.

Audience suitability. For anyone studying structural geology.

Distributor. Gulf Research and Development Co., Box 2038, Pittsburgh 30, Penn.

SOLAR ENERGY. 16 mm. Sound. B. and W. 22 minutes.

Résumé. Originally produced for TV under the auspices of the California Academy of Sciences and filmed mainly at the Bell Laboratories, this picture is now at a fee, available to anyone for non-commercial use. It briefly describes the sun, and shows some unusual solar flares in the corona, then considers the theoretical sources of solar energy. It also pictures several ways in which this energy can be utilized today, and looks briefly at future possibilities.

Audience suitability. For any earth science class studying the role played by our sun in the evolution of life and our earth's physical features.

Distributor. For preview or purchase ($125) write Almanac Films, Inc., 516 Fifth Ave., New York 36, New York.

STORY OF NICKEL. 16 mm. Sound. B. and W. 30 minutes.

Résumé. The mining and smelting of nickel are first pictured, followed by the rolling and milling of billets and other forms of the metal at a Canadian plant of the International Nickel Company.

Audience suitability. Primarily for engineers but of limited interest to mining geologists.

Distributor. Graphic Services, U.S. Bureau of Mines, 4800 Forbes St., Pittsburgh 13, Pa.

SULPHUR. 16 mm. Sound. Color. 20 minutes.

Résumé. Sulphur is used in manufacturing a host of products—rubber, steel, paint and explosives to mention only a few. This film tells briefly the story of this important element, its sources in salt domes and mines and sour gases, its extraction and concentration by the Frasch and other processes, its storage in great multimillion ton blocks, and finally its distribution and use in our industrial economy.

Audience suitability. For economic and mining geologists and engineers.

Distributor. Graphic Services, U.S. Bureau of Mines, 4800 Forbes St., Pittsburgh 13, Pa.

SUPPLEMENTAL CONTROL FOR TOPOGRAPHIC MAPPING. 16 mm. Sound. Color. 32 minutes. 1952.

Résumé. This film reviews major control methods used in gathering data for topographic maps, including the use of air photos, altimeters, and plane tables with stadia rods (in the film the "engineer" places his notebook on the plane table and then *writes* on it!). Maybe this is why some map contours don't match field topography. Triangulation and three-point resection are also discussed.

Audience suitability. For those studying geologic field methods, civil engineering, and photo geology.

Distributor. Map Information Office, U.S. Geological Survey, Washington 25, D. C.

10,000 FEET DEEP. 16 mm. Sound. B. and W. 20 minutes.

Résumé. After briefly explaining the use of the Brunton compass, this film discusses seismic exploration, and the selection of drilling sites for oil tests. It then shows portable and heavy duty rigs at work, and describes some of the problems encountered in drilling wells in the Louisiana swamps.

Audience suitability. For elementary classes in economic, engineering, and field geology.

Distributor. Film Library, Shell Oil Co., 160-07 Northern Blvd., Flushing 58, New York. Also at Shell offices in Chicago, Houston and San Francisco.

THIS IS ALUMINUM. 16 mm. B. and W. 30 minutes. 1947.

Résumé. After a brief introductory discussion of bauxite and its geologic occurrences

this film pictures in some detail the refining, milling and fabrication of aluminum metal, and its many uses in our modern industrial economy. The electrolytic process, much improved since its original discovery by Hall in 1886, is explained; and there is also a short sequence on ore purification by the lime-soda sinter method developed during the second World War to process low grade bauxites.

Audience suitability. A film primarily of interest to metallurgists and engineers.

Distributors. Aluminum Co. of America, Motion Picture Section, 1501 Alcoa Bldg., 425 Sixth Ave., Pittsburgh 19, Pa. (User must pay insured shipping charges BOTH ways.)

THRU SUEZ FOR OIL. 16 mm. Sound. Color. 16 minutes.

Résumé. Beginning about 1949 several American oil companies pooled their resources to start explorations in the Neutral Zone between Kuwait and Saudi Arabia. Production there now tops 40,000 barrels per day, a result which, if current lawsuits are disregarded, must be considered eminently successful. Here on film is the story (briefly) of the extensive logistical planning which has produced this record, from early conversion of L.S.T. 1014 into the hotel "Aminoil", to the final production of flowing wealth from desert sands.

Audience suitability. For any group interested in the many facets of planning foreign exploratory oil operations.

Distributor. Kerr McGee Oil Industries, Inc., 306 N. Robinson, Oklahoma City 2, Okla.

TOPOGRAPHIC MAPPING BY PHOTOGRAMMETRIC METHODS. 16 mm. Sound. Color. 40 minutes (1st reel); 38 minutes (2nd reel).

Résumé. In the first of these two reels, third order surveying with theodolite and level, accurate to about one part in 5,000, is contrasted with air photo surveys done with the aid of stereo pairs and photo indices, which require supplementary vertical control commonly by plane table and rod work on the ground. In the second reel the plotting of latitude and longitude on photos is discussed. Then comes a brief description of the multiplex plotter (red and blue-green stereo spectacles are needed for a brief sequence), followed by a discussion of field checks of office work and office corrections based on field work.

Audience suitability. Primarily for classes in geologic field methods, photogeology, and civil engineering.

Distributor. Map Information Office, U.S. Geological Survey, Washington 25, D.C.

TRANSIT TRAVERSE FOR TOPOGRAPHIC MAPPING. 16 mm. Sound. Color. 25 minutes. 1950.

Résumé. Transit surveying methods used in topographic mapping are here explained, with pictures showing the use of the standard transit and its lighter weight modern counterpart—the 22 pound optical reading theodolite. Also demonstrated are techniques for measuring distances with steel tapes, stadia rods and range rods, and for recording notes.

Audience suitability. A well planned and effectively presented film, but technical, and should be used only after viewers have previously had some instruction in the subject. Primarily for those studying field geologic methods.

Distributor. Map Information Office, U.S. Geological Survey, Washington 25, D. C.

TRIANGULATION FOR TOPOGRAPHIC MAPPING. 16 mm. Sound. Color. 30 minutes. 1953.

Résumé. Third order triangulation instruments and methods used by the U. S. Geological Survey (1st and 2nd order methods are handled primarily by the Coast and Geodetic Survey) are pictured and described, followed by brief accounts of the use of helicopters for inaccessible areas, and the plotting of field data in the office.

Audience suitability. For classes in geologic field methods.

Distributor. Map Information Office, U.S. Geological Survey, Washington 25, D.C.

JOURNAL OF GEOLOGICAL EDUCATION
Vol. 6, No. 2, Fall 1958. pp. 22 - 27

THE GEOLOGIST IN AN OIL COMPANY

F. GOLDSTONE
Shell Oil Company, Houston, Texas

ABSTRACT. A chart of the Shell Oil Company geological staff is presented showing the number of men who pursue professional type work and the number who enter the general practice of petroleum economic geology. It is pointed out that the background of training for these two principal categories of geologists in an oil company may well be quite different; whereas the man going into economic work is better off with an engineering type background, this may be quite inappropriate for a paleontologist or specialist in some other branch. In Shell, the geologists headed for general exploration duties enter through a training program including formal courses in such engineering subjects as geophyics, petrophysics, and reservoir mechanics, which require a solid background in mathematics and physics as a prerequisite. Stratigraphers, paleontologists and research geologists are hired on a basis of their orientation toward narrower fields and may engage in purely scientific work during a major part or the whole of their careers. As the search for oil becomes more difficult the services of the expert assume relatively greater importance and the professional man may well be in increasing demand. Particularly at the graduate school level it should be recognized that the opportunities for a professional career with an oil company exist, and no attempt should be made to standardize the pattern of training where this involves curtailing or discouraging advanced work in specialized fields.

The author cannot speak for the industry as a whole, but only for the Exploration Department of Shell Oil Company to whom he is indebted for permission to release certain figures presented herein. In exploration, Shell's operations throughout the United States and Canada represent over five percent of the industry and accordingly these statistics can be accepted as a substantial sample. Shell is generally credited with being technically inclined and will lean towards greater emphasis on scientific attainment in both research and operating personnel than would characterize the industry as a whole, although it may be fairly representative of major company practice.

It has been pointed out that the geologist in an oil company becomes somewhat compartmented early in a typical career; some become "resident experts", some "geologists-in-search-of-oil". In this discussion the former group is referred to as "professionals" and the latter as "operators" with no disrespect implied to either group. In order to clarify the figures presented as Plate 1 it is necessary to define the terms. "Professionals" include geologists who are engaged principally in their specialty; paleontologists, stratigraphers, photo and field geologists, petrographers, etc., are so classified. The "professionals" can be divided into two groups: those working in our research organization on fundamental problems and those offering direct service to "operations". Everyone else who started with the company as a geologist and has remained in exploration is classified as an "operator".

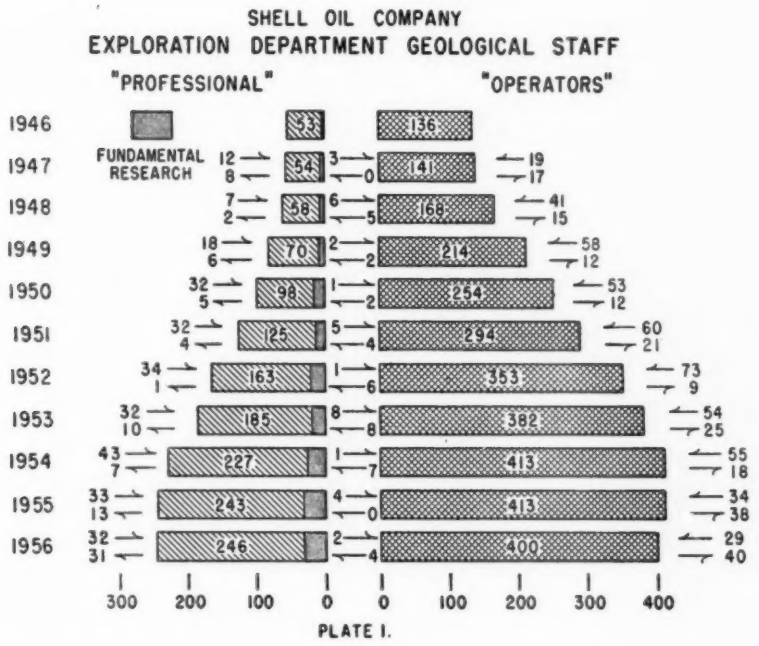

PLATE I.

Plate 1 presents the geological employment picture in Shell for the past eleven years. The block on the right are "operators" in our terms of reference. Additions each year are shown by incoming arrows and losses by outgoing arrows. Transfers from the ranks of "professionals" to "operators" and vice versa are also shown. The blocks on the left show the "professional" staff broken down into "research" and "service". From modest levels right after the war the geological staff has more than tripled. Starting with a staff of 136 "operators" and 53 "professionals" we have added 476 by recruiting to the former group and lost 204 by terminations. The 53 "professionals" of 1946 have grown to 246 in 1956 as a result of 275 hires and 87 terminations. Between the two groups the flow has been both ways; 38 to "professional" from "operators" and 33 the other way.

To understand Shell's recruiting procedure it is necessary to examine the organization of the company in the U.S.A. and Canada. Operations are conducted by seven Areas, each virtually autonomous and having its own staff of "resident experts"; fundamental research is the responsibility of a separate organization, Shell Development Company, with its exploration and production laboratory in Houston. A "staff" group, Exploration Technical Services Division, acts as liaison between Management in New York, the seven Areas and Research. One function of Technical Services is to organize centralized recruiting and training facilities which include a Geological Training Program. A different

treatment for "operators" and "professionals" is evident from the first job interview. Geologists destined for fundamental research are most frequently interviewed by a representative of the research laboratory and would invariably be brought to Houston for very careful screening by the research staff; candidates are drawn from top students with strongly developed specialties and frequently with research or teaching experience. "Professionals" headed for the staff of one of the Areas, are sometimes first contacted by a recruiter during a formal on campus visit but frequently come to us through professional contacts between Shell staff and faculty members. Again the critical factor will be a strongly oriented interest in a specialized field such as paleontology, petrology, and so on. These "professionals" are usually integrated immediately into the Area staff without passing through a formal training program, but in their first few years will receive much training in fields related to their specialty.

The largest block of geological recruits are the potential "operators" who are selected largely by on campus recruiting teams who visit more than thirty geology departments each year and personally interview some 50% of all graduate students in geology. Selected candidates are first passed through a geological training program before being assigned to operations. This program starts out with six months of surface mapping under the very close supervision of an instructor who, with a qualified assistant, handles groups of eight or ten trainees. This phase of training is similar to the field camps run by various geology departments excepting that it includes a solid four months of individual field mapping on a project selected as being of economic interest as well as appropriate for instructional purposes. A course in photogeology is coordinated with the field work. The trainee is then given six months of varied experience in all phases of petroleum exploration. An effort is made to give him contact with a wide variety of problems in the field, on the derrick floor and in the Division office partly to stimulate his interest and prepare him for the third phase of training. This comprises four months of organized class work given in our Houston Technical Services plant during which a good graduate school level of instruction is maintained. Classes are in the full academic tradition, complete with graded quizzes. The subjects taught include geophysics, petrophysics, reservoir engineering and subsurface geology, all presented by Shell specialists in these fields and at a level well above the "survey" type of course which one finds in some college curricula. We believe this type of training can be given better by our staff with the wealth of practical experience available to us than is possible at a university. The material presented is loaded with derivations requiring a good grasp of calculus, particularly differential equations, which results in those students who have sound preparation in basic science making by far the best showing. The program requires sixteen months' time and an expenditure of some $10,000 per man before the recruit is ready to take his first work assignment.

Training within the company is not limited to the newly hired employee. Courses are presented ranging up to five months in duration to geologists at all service levels. Such courses are most frequently in subjects involving rapidly developing technologies or applications peculiar to our industry.

In discussing geological curricula the question frequently arises why so much insistence on basic scientific subjects such as math and physics. In the first place, it is our experience that the more fundamental the knowledge, the less is the probability that it will be acquired after leaving the campus. Since modern technologies available to the operating petroleum geologist are such that he cannot appreciate their possibilities, and still less their limitations, without a sound scientific background we are forced to the conclusion that this is a necessary part of his academic training. Except in rare instances we do not expect by our training programs to develop experts in such fields as geophysics, petrophysics or reservoir engineering from our operating geologists. But we do expect them to approach such subjects with a well developed critical faculty which is necessary if data from widely diverse fields are to be integrated into a single interpretation. This, of course, applies mainly to the operating geologist. So long as a geologist remains a specialist in a relatively narrow field, his background of training in subjects not essential to that field is of lesser importance. For instance, if a selection must be made, a paleontologist or palynologist is better off with strong courses in zoology or botany rather than with advanced mathematics; on the other hand, a clay petrologist should have advanced physical chemistry even if he sacrifices zoology and mathematics. One subject on which there seems to be general agreement amongst major companies is that training in the application of fundamentals to problems peculiar to the oil industry is best left to us. The trade school type of training is not what we want.

What then can we conclude as to the prospects of a graduating geologist getting started and advancing with a major oil company?

For the top flight student at the Ph.D. level who has developed a strong specialty there is not too much of a problem. He will in 90% of the cases be dedicated to a "professional" career and will gravitate into teaching, research or some specialized field of service. As Plate 1 shows, he has rather fewer jobs to go after in our organization but then again he will be up against less competition.

At the other end of the scale the bachelor, however promising he may be, will find difficulty in getting started with a major company which conducts centralized recruiting. This does not imply that he may not potentially be an outstanding success in the oil industry; many of us know men who just scraped through with a B.A. but by virtue of a "flair" for the oil business or administrative ability or just plain luck are tremendously successful. But in these days of centraiized recruiting the bachelor is at a disadvantage because the recruiter has such difficulty in appraising him. As a rule, faculty recommendations at the bachelor level are not too dependable, particularly in large departments. Grade point averages can be very misleading, not so much in failing to identify brilliant students but in completely masking some potentially good men who have not yet found themselves. A student at the bachelor level who is still eager and able to learn is quite acceptable as a candidate for our training program and may well be adequately prepared for a career in the oil business but will have a tough time getting started in competition with graduate students.

We find that graduate students with a master's degree are, in general, at the desired level for our training program leading to a career in operations. They have been screened initially as to their scholastic potential before admission to graduate school and faculty references on the score both of native ability and personal traits are usually more reliable. In operations we still are looking perhaps above everything else for the man with the "flair" for the oil business, which is so easy to recognize after he has been with us for five years but so hard to detect in a thirty-minute interview. The feeling is generally shared by many major company recruiters that one is just as likely to find this "flair" in a graduate student and when recruiting at that level one is less likely to hire those of limited potential.

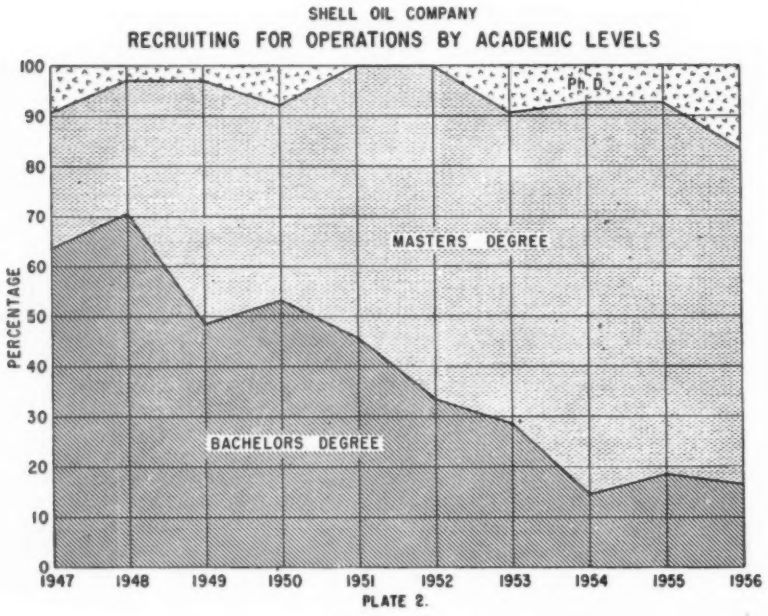

PLATE 2.

Plate 2 shows the trend as regards level of academic training in our hiring for operations and serves to emphasize the preference we have for men at the master's level. For the "professionals", particularly in the field of fundamental research, the academic levels of those hired would trend even more towards advanced degrees.

The conclusion is reached that there are positions open in the petroleum industry for geologists with a variety of backgrounds but that students should be made to realize that their choice of a future career may well be determined by their election of courses and degree of specialization whilst still in college. Careful counseling of students is necessary so that they be directed to qualify for the

particular type of career they envision for themselves. The scientifically minded who aspire to a "professional" career would be well advised to develop a specialty whilst still at the university with the clear foreknowledge that their future will most probably lie in their specialized field and as their stature grows, it will become increasingly less likely that they will make a lateral move into an operating type of career. As the technologies of the oil industry become more and more advanced the demand for specialized services will be ever greater and the importance of the expert will increase. A career of this type is rewarding both in the nature of the work and, now-a-days, in the salary which can be attained. The man who seeks a wider horizon and who aspires to direct an exploration organization should go after the broadest possible background including a strong engineering content, as in this way he will not only be better equipped to deal with a wide range of techonoligies but he will have a better chance of being selected for training and advancement in the channels which lead to management.

We are looking for well trained geologists who still have a thirst for additional knowledge and a trained capacity to learn which will assure their continued development after leaving the academic fold. We in industry appreciate the steady flow of well trained men made available to us by the various educational institutions and will cooperate to the extent of our ability, stimulated by a healthy self-interest, to better that training.

TRANSACTIONS—Continued from page 36

vened at the conclusion of the papers at the Geology-Geography session of the Northwest Scientific Association.

Norman Anderson, Vice President, presided during the delivery and discussion of two excellent papers. After delivery of a paper by Professor Kenneth Grimm, University of Idaho, on the subject of the place of field methods courses in the curriculum, the subject of section promotion of a cooperative field camp was introduced.

In the business session, presided over by President C. D. Campbell, announcement of the ballot election of officers was made by the Chairman of the Nominating Committee, Joseph Mills. The Secretary was instructed to cast a unanimous ballot for the new officers.

Earl Cook, University of Idaho, was nominated as Section Representative to the AGT meeting to be held at Saint Louis in November, 1958, in conjunction with the GSA.

President Campbell suggested that additional meetings be called for group field and laboratory inspection in the vicinity of an institution within the section. He also requested suggestions for a possible panel topic or outside speaker be made to the officers before the next annual meeting, which will be held in Corvallis, Oregon, December, 1958, with the Northwest Scientific Association.

Respectfully submitted,

EDWARD P. THATCHER, *Secretary*

BOOK REVIEWS

Physical Geology. L. Don Leet and Sheldon Judson. 502 pp., 412 figs., 37 tables. Prentice-Hall, Inc., New York. 1958. $7.50.

This second edition of Leet and Judson's *Physical Geology* is a reorganized, revised, and almost new book. Three new chapters are Minerals, Geologic Time, and Lakes and Swamps; other separate chapters are created from previous combinations. In some chapters every sentence is rewritten with drastic reduction; in others only introductory paragraphs are new with large sections bodily reprinted with hardly a change. The chapter on The Earth's Age and Place in the Universe is eliminated. Many fine photographs still adorn the book. Colored end papers of three geological sections across Canada, across the United States, and across Mexico are an innovation.

The book is still written for the moderately intelligent student with a modern background in elementary chemistry and physics. Chapter 2 on Matter and Energy, a real stumbling block in the first edition, now is so simplified and understandable that all except the uninterested student will find little difficulty with it. The lecturer, however, still may need to justify such information. Explanation later comes in part in the following chapter on Minerals with the relationship between the chemical and physical properties of minerals and their internal atomic structure. Appendix C now is in part an 8-page Common Minerals identification chart.

In the chapter on Geologic Time, the Geologic Column and Time Table are especially modern with the avoidance of the terms Tertiary and Quarternary. In later chapters, the concepts of peneplanation and of cycles of erosion unfortunately still are considered worthy of attention. The excellent chapter on Glaciation is prefaced by an introduction to glaciology. The treatment of arid and semi-arid region landscapes in the chapter on Deserts is far too scanty for its importance and still needs amplification. Lakes and Swamps offers unexpectedly interesting new material. The latter part of the book on Rock-Deformation and Mountain-Building, Metamorphism, Earthquakes, and The Earth's Interior involves the deepest thinking type of geology and is well done, with latest ideas and present status of controversial subjects offered as well balanced summaries of opposing theories. The Glossary of 706 items (598 in the first edition) stands independently as a dictionary of geologic terms.

This top-notch textbook should bring to geology, as a young science still, the high standards of endeavor and respect that chemistry and physics now enjoy. This edition, so tremendously improved over the first, certainly deserves a second serious consideration by all teachers of geology.

SIDNEY E. WHITE
The Ohio State University

Earth for the Layman. Mark W. Pangborn, Jr. 68 pp., American Geological Institute, 2101 Constitution Ave., Washington 27, D. C., 1957. $1.00.

Earth for the Layman, by Mark Pangborn, Jr., is a selected, annotated bibliography of the earth sciences. It will be most helpful to the layman to whom it is addressed, but the professional geologist also will find it a treasure house of references which he can recommend to many groups—librarians, students, children, Boy Scouts, anyone who is interested in finding out something about geology. Many of the references listed are designed for boys and girls of junior and senior high school ages. It makes more effective the excellent popular books and booklets on geology and closely allied subjects, many of which are new and not known to some of our profession.

It is the teachers of geology, in the opinion of the reviewer (who is a geology teacher), who will find the book invaluable. So often the teacher is asked to recommend a book for a specific audience—perhaps children, perhaps adults who have had no formal introduction to geology. In *Earth for the Layman* he can readily discover what is available to meet the particular need.

The book is in two parts. Part I, on 46 pages, lists 955 references in the earth sciences by topics. Part II, 21 pages long, lists 715 regional references by State. In the latter part, under the name of each State, are listed by number pertinent publications listed in Part I—there is no duplication of titles in the two parts. The comments by the compiler are concise and relevant.

In the regional listings the District of Columbia is included, but the states of Arkansas, Delaware, Iowa, Nebraska, Rhode Island, and South Carolina are not. It is hoped that in future editions all states will be represented.

All in all, Mark Pangborn has done the earth sciences and their friends a real service.

RICHMOND L. BRONAUGH
Baylor University

General Geology Laboratory Workbook. Samuel P. Ellison, Jr., Editor. Harper & Bros., Publishers, New York. 1958. x + 285 pp. $3.75.

This newest member of Harper's Geoscience Series is a paper-bound workbook that is somewhat more complete and elaborate than most workbooks for general geology. The book consists of 34 exercises, which differ considerably in style and in time required for proper accomplishment. Twenty-two are concerned with topics in physical geology: minerals and rocks, topographic map construction and interpretation, and physiographic analysis. Six deal with the classification of animals and plants. One, in six parts, consists of block diagrams, in the flat and with only part of the geology shown, which the student must cut out, fold and paste into a solid figure, and complete by diagramming the geology on the blank faces. Five exercises are planned for work with various geologic maps supplied in the laboratory. In addition, there are six diagrammatic geologic maps that may be employed in various ways, and sheets on which field trip reports may be made. Supplementary to the historical exercises are homework outline sheets for each geologic period, on which the student may summarize the salient features of each period in North America. On the back of each is an outline Map on (*sic*) Outcrops and Paleogeography. These outlines and maps should be very helpful to the student of historical geology, by permitting him to organize a wealth of detail in a small space for learning and for review.

Most of the exercises are designed for use with whatever topographic and geologic maps or other materials the instructor may wish to use. Suggested lists of such items are included with each exercise. All the exercises are flexible in that regard, which makes it unlikely that files of completed exercises will be gathered by students and copied from year to year. The study questions and lists of appropriate references that accompany most of the exercises are generally excellent. Each topic covered is introduced by a brief treatment of the subject, as a reinforcement of lectures and text assignments. All the pages are perforated for ready removal for submission to the instructor.

Although this workbook is a versatile and effective teaching aid, and perhaps the best such available, it does have some unfortunate aspects. Fluorescent light is considered synonymous with black light (p. 5). In the study of regional stream topography, no clear distinction is made between landforms in arid and in humid regions. The term paternoster lakes is little used by present-day glacial geologists. Ice sheets surely are normally characteristic of high latitudes rather than high altitudes (p. 125). The study of shorelines and shoreline processes is built around the outmoded and misleading classification into emerging, submerging, neutral, and compound shorelines (p. 151-159). Some of the modes of expression in the descriptive paragraphs are hardly good examples for impressionable college students: e.g., p. 201, "The student will find historical geology fascinating and easy to learn if he takes time to organize himself on these summary outlines." Notwithstanding objections of this sort, this imaginative workbook is a good one, is reasonably priced, and merits the serious consideration of anyone responsible for college courses in elementary geology.

MALCOLM P. WEISS
The Ohio State University

A Workbook for Invertebrate Paleontology. James F. L. Connell. Part I, vi and 99 pp; Part II, v and 106 pp. Wm. C. Brown Company, Publishers, Dubuque, Iowa, 1958. Part I, $1.75; Part II, $2.00.

Few academic fields have a greater lack of

standardization of teaching method than paleontology. Many factors produce combinations unique in each department. Nevertheless, Dr. Connell has made a brave effort to get one system off home base.

Among the problems in the work is one which plagues the subject itself more than teaching techniques, namely, classification and taxonomic order. Dr. Connell's solution is a faithful adherence to the classification used in *Invertebrate Paleontology* by Twenhofel and Shrock, 1935, and in its defense he states, "The writer is of the opinion that such standard schemes are desirable on the undergraduate level." Potential book customers might question the use of a 1935 outline in a 1958 publication, especially since that classification was fundamentally revised in the newer texts, *Principles of Invertebrate Paleontology* by Shrock and Twenhofel, 1953, and *Invertebrate Fossils* by Moore, Lalicker, and Fischer, 1952, to which references are made throughout the workbook.

But perhaps calling graptolites coelenterates and trilobites crustaceans, or placing echinoderms taxonomically between coelenterates and bryozoans does not destroy for the paleontology student (who probably already has learned better from his elementary course in Historical Geology) the significance of features and ranges of many well-chosen genera.

The manual is a guide to facilitate the "learning of fossil species by handling and illustrating the specimens." The major groups are described and the classifications explained. Representative genera and species are listed with geologic ranges and instructions for drawing them. Supplementary references are made to illustrations in *North American Index Fossils* by Shimer and Shrock, *Invertebrate Fossils* by Moore, Lalicker, and Fischer, *Principles of Invertebrate Paleontology* by Shrock and Twenhofel, and *Foraminifera* by Cushman. Generic descriptions are given only for foraminifera.

Interspersed with the pages of descriptions and instructions are the plates, each lined in quadrants showing outlines of two fossils to be drawn, their names, classification, geologic range, and features to be labeled. Regrettably no reference is made for indicating the scales of the drawings. The work is distributable over two terms, and the 200 selected genera represent a wide range of significant fossils. Deletions and substitutions are suggested. There is an exercise on preservation of fossils, and both parts of the manual contain the geologic time scale.

The spiral-bound books are in attractive paper covers and measure 8½ x 11 inches, with large, clear type on fairly heavy paper. The perforated plates may be easily detached. There is a minimum of grammatical or typographical error and relatively few ambiguities or misstatements in definitions and descriptions.

Thus, for those who would not worry about using an obsolete classification, the workbook is an adequate laboratory facility.

RALPH H. BOND,
Capital University

TRANSACTIONS
OF THE
ASSOCIATION OF GEOLOGY TEACHERS

CENTRAL SECTION

The 18th Annual Meeting of the Central Section of the Association of Geology Teachers was held at the Missouri School of Mines at Rolla, Missouri, April 25th and 26th, 1958.

The first part of the meeting consisted of a field trip which visited the Leadwood Mine of the St. Joseph Lead Company. All morning was spent underground, and opportunity was given to see many of the interesting features of these south-eastern Missouri lead deposits. Early afternoon was spent in visiting the concentrating mill.

The evening banquet was held in the Pine Room at Rolla, Missouri, and was followed by an address by Dr. J. S. Brown, the chief geologist of the St. Joseph Lead Company. His topic dealt with the geology of the Pea Ridge iron deposit near Sullivan, Missouri, now being brought into production. This deposit was discovered through the application of geophysics. The Missouri State Geological Survey, The United States Bureau of Mines, the United States Geological Survey, and the St. Joseph Lead Company had all been active in the use of air-borne magnetometer as a prospecting tool.

A large magnetic anomaly at Pea Ridge located by the 1949 survey was drilled by the St. Joseph Lead Company, which found 1000 to 1500 feet of high-grade ore in some of its test holes. The finding of this ore illustrates the usual modern method of discovery —namely, the intelligent piecing together of bits of information from many diverse sources.

The deposits are replacements of brecciated rhyolite with magnetite and minor hematite. The deposit strikes east-west and has an almost vertical dip.

Design for the concentrating mill is being made by the Bethlehem Steel Company on the basis of core samples taken from the test holes. The main impurities are silica, phosporus, and sulphur. It is planned to recover the magnetite by a magnetic method and the hematite by a floatation method. The ore minerals are associated with fluorite, actinolite, secondary silica, and quartz.

Other magnetic anomalies are at present being investigated. So far none have been found which contain good ores.

It is planned to produce two million tons per year of marketable iron ore concentrate from three and a half to four million tons of primary ore. This amount is four or five times the present size of iron production in Missouri.

The next morning the group was treated to a tour of the facilities of the Missouri Geological Survey and of the topographic branch of the United States Geological Survey in Rolla. After luncheon and a tour of the Geological Department of the Missouri School of Mines, conducted by Dr. Oliver R. Grawe, the business meeting convened. Thirteen members and six guests were present. The minutes of the 17th annual meeting were not read since they had been published in the "Journal of Geological Education." The treasurer's report was read and accepted.

It was moved, seconded, and passed that the new officers be authorized to contribute up to $100 to the National Association for use in publishing the "Journal of Geological Education" if the need for such funds is still evident.

The nominating committee report, read by Roger Spitznas in the absence of Keith Hussy, recommended that the new officers be elected by mail ballot to be completed before the end of May. This recommendation was accepted. It was later decided to defer the election until fall, and the present officers agreed to serve until new ones could be elected.

The report of the budget committee was read and accepted. The business meeting was adjourned. It was followed by a program of three papers whose summaries follow.

SUMMARY OF CHRISTOPHER AMSTUTZ'S PAPER

The first was given by Christopher Amstutz, Missouri School of Mines, on the mineralogy teaching of Paul Niggle. Courses described were taken during the junior and senior years.

First semester: Since all science searches for principles which classify natural phenomena, Niggli approached the systematic study of mineralogy through the study of the symmetry, elements of crystals, their external forms, point groups, and stereographic projections of crystal forms. The last part of the course included interpretation of phase diagrams important in mineralogy.

Second semester: The second course was called crystal optics and physics and included optical crystallography and X-ray crystallography.

Third semester: This course was a study of the principles of crystal chemistry illustrated with numerous models of crystal structures.

In his teaching Niggli always emphasized learning the principles rather than mere facts. He felt the study of these natural laws would aid the individual student in finding his own life's principle and develop the right kind of thinking on the part of the individual student.

SUMMARY OF CHAUNCY D. HOLMES' PAPER

The second talk was by Dr. Chauncy D. Holmes, University of Missouri, titled "Hazzards of Subdividing Geology." Probably those other than geologists are responsible for subdividing geology much more than the geologists themselves. There has been a tendency in recent years for geology to be dissected and part given to physics (geophysics), part to chemistry (geo-chemistry), and so forth. Have geologists helped prepare for this subdivision? There will probably always be a need in our institutions of higher learning for an integrated and unified study of geology in its broad scope.

In the discussion of this paper it was pointed out that geologists are not alone with this problem. It is due largely to the great and rapid growth of knowledge.

SUMMARY OF DR. OLIVER R. GRAWE'S PAPER

The third paper of Dr. Oliver R. Grawe, Missouri School of Mines, was titled "Facts and Fetishes in Education." At present there are three million college students in the United States, and it is estimated that ten years will double this number. One answer that has been proposed to this mass of students is mass production methods of education, such as large classrooms and TV classes. However, large classes decrease the efficiency of education since nothing can replace the face to face intercourse between student and instructor. New problems such as those which would arise from the exploration of space will call for real thinkers, not just technicians. Some of the more immediate problems are:

1. Adequate teaching staffs. One suggested answer is higher salaries for teachers. This can, however, become a fetish and is not the sole solution to the problem. Most teachers do not enter the profession to get rich. Usually teaching itself is the primary impetus.

2. Government financial support for education. The fetish here is the concept that education can be bought whereas much more is involved than the simple expenditure of money.

3. We have almost tacitly assumed that everybody has a right to go to college. Many are not ready to take a college education. Many desire only to learn techniques. For these an intermediate school or trade school rather than "higher education" could usefully be provided. We must distinguish between education and training.

4. Specialization at a very early age. Specialization too early is detrimental not only to the individual, but to his future employer. Schools must emphasize "basics." Industry can provide the training in the special techniques which it needs.

5. The fetish of research. Educational administrators sometimes place more value on research than on teaching. There is great pressure to turn universities into research institutes. The basic function of a school is to teach, and this must never be lost sight of.

6. Accreditation. This is encountered particularly in engineering schools. Accredita-

tion can have only one valid basis—a capacity to judge the teaching ability of the faculty. Other bases of accrediting are minor.

7. Many things are equally as important as technical skills. Professional ethics, for instance, are best taught by example. The use of clear and concise English is a vital necessity. All the English courses in the world will not necessarily help if the student is not forced to use and practice it by all of his teachers. Foreign languages are especially useful to today's student and should be included in any educational program.

A discussion of the paper hinged around two main points. First that what we really need is quality and thoroughness much more than we need large numbers of poorly trained students. Second, regarding accreditation, it was said that the teaching ability of a faculty can truly be judged only through their product so that "by their fruits ye shall know them."

Respectfully submitted,
DOROTHY J. GORE, *Secretary*

EASTERN SECTION

On Saturday, December 14, 1957, twenty-one geologists from C.C.N.Y., Franklin & Marshall, Hofstra, Lafayette, Lehigh, Newark Rutgers, Princeton, Renssalaer, Rutgers and Upsala met at Rutgers at the third annual informal meeting of the Eastern Section, Association of Geology Teachers.

The meeting started with some remarks by Helgi Johnson, Chairman of the Department of Geology at Rutgers. He informed the group that a new $3,500,000 Geology Building has been given a top priority in the building program. The department has a staff of seven and at present has 20 majors per year. In addition to the students in the College of Liberal Arts and Science, engineers, students of agriculture, and of ceramics take courses in geology.

Geology is also taught at Newark Rutgers by a small department and, this year for the first time, is being offered at the Camden division of Rutgers. They are also looking forward to an expansion of geology at Rutgers since Douglass College, the women's division of the University at New Brunswick is now encouraging its students to take courses in geology there.

At the Bureau of Mineral Research at Rutgers, glass sands, industrial sand, feldspar and light weight aggregates have been studied. At the present time the emphasis is on clay research and illmenite. The work has been carried on in association with the New Jersey State Geological Survey. The department would like to have the State Survey in the new Geology Building as at Illinois and West Virginia.

The Geological Museum at Rutgers is viewed as a teaching Museum. Groups come to the Museum from public schools and high schools in the New Brunswick area. Prior to World War II, the Museum had a Curator. It is now hoped to get one again. Helgi Johnson is especially proud of a wonderful specimen showing a multitude of dinosaur tracks. The slab was obtained from the Morris Plains-Boonton area and is believed to be one of the finest in the world.

A feature which impressed the group was a large pine-panelled Geology Department Faculty-Student Lounge. It also serves for Geology club and staff meetings.

The group also visited the Bureau of Mineral Research, the petrographic laboratory with its 21 petrographic microscopes, the polished section laboratory and classrooms.

After lunch we met in the faculty-student lounge for a discussion of the undergraduate curriculum at Rutgers. Geology is taught in the School of Arts and Sciences in Rutgers. The student typically starts his Geology sequence in the Sophomore year with Physical followed by Historical Geology. In the Junior year, Mineralogy, Petrology and Paleontology are offered, sometimes with Stratigraphy and Structural Geology. In the Senior year, Optical Mineralogy, Microscopic Petrology, a full year of Economic Geology and Field Geology are taken. The Department also offers as electives Geomorphology, Photo-interpretation (Photogeology) and advanced General Geology.

In his Freshman year, the student who is going into Geology must include in his program Chemistry, Physics and Mathematics. Although students typically start Geology in their Sophomore year, it is possible to start majoring in Geology in the Junior year at Rutgers.

Freedman, of Franklin and Marshall, felt

it was better to start Geology in the Freshman year so as to get the "feel" of Geology. Johnson of Rutgers said he would like to introduce Geochemistry and Geophysics into the undergraduate curriculum since oil companies say that Geophysicists have insufficient Geology for their work.

It was pointed out that at Lafayette and at Princeton a Senior thesis is required in Geology. At Rutgers if a man is deficient in written or oral English, the degree can be withheld.

The consensus of the group was an opposition to open-book exams. Dorf of Princeton feels that it is "spoon feeding" the students. He said that when a student puts the work in order and arranges the subject matter of a course in his mind much is gained. Montgomery of Lafayette agreed that a student loses an orientation to the course if he does not study.

Dorf felt also that we learn more from an oral exam than from a written exam. He, however, agreed that time would not permit oral exams in an undergraduate curriculum.

The question was raised as to what we can do about the coming emphasis on Ground Water Geology. Dorf pointed out that Ground Water Geology is a coming field in the U. S. Geological Survey. Martens of Rutgers includes some of this material on the graduate level in Economic Geology. At Lehigh there is a one semester course in Ground Water Geology on the graduate level. Johnson remarked that the head of the Kansas Geological Survey said that unless one has had Engineering first, Ground Water Geology is useless.

Johnson made note of the most comprehensive book in English on Photogeology—Helbling, Robert, Studies in Photogeology. *Federal Institute of Technology in Zurich, Art. Institute,* Zurich, Orell Füssli, 1949. This is comparatively up to date and gives case histories.

In conclusion, it was noted that at Rutgers during the past two years, Geology as a chosen major has become more common than formerly, when failing engineers and other science majors often switched courses in midstream to Geology.

Rosenholts of Rensselaer emphasized that oil companies are very much interested in getting Rensselaer Geology Majors even though they have had no graduate work.

The Eastern Section of the Association of Geology Teachers held its eighth annual meeting on April 4th and 5th at Lehigh University, Bethlehem, Pennsylvania, with 45 geologists from 20 colleges attending.

On the afternoon of April 4th, the members of the Eastern Section were invited to attend the annual meeting of the Pennsylvania Academy of Science at Lafayette College in nearby Easton.

After the annual dinner at the new University Center, Earling Dorf, Section president, thanked the Lehigh Geology Department for their invitation to Lehigh. The business meeting was held at Williams Hall, starting at 8:30 P. M. Maurice B. Rosalsky read the treasurer's report which revealed that even though the sectional dues had been reduced from $1.00 to $.50 per member, the running expenses per member were still within the latter figure. He also read the membership report which showed ten members dropping out and 17 new members added. The section now has the highest membership in its history—137 members.

The slate of officers presented by the nominating committee (see inside back cover) were elected—the first three by mail ballot, and the editor, Lawrence Whitcomb, at the meeting. Earling Dorf was elected as section representative on the National Nominating Committee for 1959 to select officers for 1960. The membership instructed the president of the section to investigate means by which the section could assist the American Geological Institute in its efforts to obtain salary increases for geologists in government service.

In a general discussion, Kurt Lowe hoped that we would restore the slide symposium, so successful in the past, to our meetings. John Moss wished that Earth Science teachers from the high schools could be brought back to the programs given at annual meetings.

The section voted to accept the invitation to hold the annual meeting next spring at Bryn Mawr College. Our annual informal meeting this fall will be held at The Johns Hopkins University on December 6th. After the business meeting, Lawrence Whitcomb spoke on "The Geology of the Bethlehem

Region" illustrated by maps and lantern slides.

At 9:00 A. M. on April 5th at the University Center, the section held a symposium on "Petrology in the Undergraduate Geology Curriculum" under the chairmanship of J. Donald Ryan. John Griffiths of Pennsylvania State University, Richard Jahns of The California Institute of Technology, Clifford Hopson of The Johns Hopkins University, Kurt Lowe of The City College of New York, Leslie Spock of New York University, and Edward Watson of Bryn Mawr College spoke.

Hall Taylor, of Columbia University, spoke of the American Geological Institute taking over the project of listing 16 mm. films of geologic interest. Taylor wishes to form a working committee for listing films in the Earth Sciences, with brief descriptions.

On the afternoon of April 5th, Robert Hoy, resident geologist of the New Jersey Zinc Company conducted a field trip through the surface workings of the New Jersey Zinc Company mine at Friedensville, Pennsylvania. This mine, one of the important zinc mines of the United States, has again gone into production after a period of 65 years since the last ore was mined at this locality.

Respectfully submitted,

MAURICE B. ROSALSKY, *Secretary*

NEW ENGLAND SECTION

The Annual Meeting of the New England Section of the Association of Geology Teachers was held at Brown University, Providence, Rhode Island, on April 4 and 5, 1958. Thirty-two members representing 14 colleges, were in attendance.

On the afternoon of April 14, Alonzo Quinn conducted a field trip which featured the structure and stratigraphy of the Narragansett Basin.

Following the annual dinner on Friday evening, President Arthur Socolow presented an address entitled "Geology in the New Era of Science." The talk emphasized that in view of the coincidence of an enrollment wave, an awareness of science, and an interest in educational improvement, geology departments have an opportune moment to make changes. The changes, however, should be aimed for turning out better geologists rather than more geologists.

The Saturday program of papers was well received as evidenced by the discussions. George Swinzow, of Boston University, spoke on "Mineralography Problems and their Solution at Boston University" in which he pointed out the value of integrating polished section work with ore genesis studies. Janet Aitken, of the University of Connecticut, showed how an inexpensive home-made model of a universal stage and a stereo-net can be used to work a large number of problems which help the student develop a three dimensional perception. Helen Stobbe, of Smith College, told of the inspirational value of attending the Summer Institute for College Geology Teachers at the University of Illinois in 1957. Elroy Lehmann gave an illustrated talk describing the elaborate new geology facilities being built at Wesleyan University. James Kahn, of the University of Rhode Island, spoke on the values of statistics in the present day geology curriculum but warned of statistics improperly used or taught incompetently. Robert Garrels, of Harvard, spoke on "Little Used Methods of Representing Mineral Associations" which demonstrated the interrelated nature of minerals. Robert Shrock, of Massachusetts Institute of Technology, spoke on "The Place of Geology in the Earth Sciences" in which he demonstrated the intellectual as well as the scientific values of a geology course. Berhard Kummel, of Harvard, described a new approach to the teaching of historical geology which tends to better integrate that subject with physical geology. Clarence Miller, of the University of Rhode Island, demonstrated several eye-catching working models of geologic activities which by their actual operation are stimulating teaching aids. Joseph Peoples, of Wesleyan University, gave an illustrated talk on "Geology and Geologists in the Philippines" and Nathaniel Sage, of the University of New Hampshire, showed the magnificent array of structural and stratigraphic problems which students work with at the M. I. T. geology summer camp at Antigonish County, Nova Scotia. Donald Eckelmann, of Brown University, reported on the superior achievements obtained by giving a course in elementary geology integrated with chemistry with the help of the chemistry department.

At the business meeting the slate of officers

presented by the nominating committee was unanimously elected (see back cover). The 1959 meeting is to be at the University of New Hampshire.

Respectfully submitted,
ARTHUR SOCOLOW
(acting for Marshall Schalk who was absent through illness.)

EAST-CENTRAL SECTION

The East-Central Section held its annual meeting on March 21 and 22, at Miami University, Oxford, Ohio.

During the morning of Friday, March 21, arriving guests were greeted at an informal coffee hour in Brice Hall on the campus.

In the afternoon the section met in the University Center for a panel discussion on "Solutions to the Pending Teacher Squeeze." H. Gray Multer was panel moderator and the four members of the panel were John Coash of Bowling Green State University, Richard Mahard of Denison University, Vincent Nelson of the University of Kentucky and David Scotford of Miami University. Dr. Coash discussed the problem as it might be met by a department of moderate size; Mahard, in a small college and small department; and Nelson, in a large department. Dr. Scotford presented data on a possible solution, tried in the Miami geology department and supported by the Ford Foundation, wherein graduate students working on master's degrees were used as lecturers in the elementary classes. Following the remarks of the various panelists the meeting was thrown open for remarks from the floor. Both the panel discussion and the question and answer period which followed were tape recorded and it was announced by Dr. Multer that edited mimeographed copies of the proceedings would be made available to all attending as soon as they could be prepared.

On Friday evening members and their guests met again at the University Center for a banquet and annual business meeting. At the banquet Dr. Karl Limper, Chairman of the Department at Miami, introduced Dean and Mrs. Alderman and President and Mrs. Millett. Following the banquet Wayne D. Martin, section president, presided at the business meeting. The meeting was called to order and the minutes of the 1956-57 meeting were read and approved., as was the treasurer's report. Dr. Martin then called upon H. Gray Multer, vice-president, who reported upon the national meeting of the association in Atlantic City.

Sidney E. White, section editor, read suggestions for the work of a section editor, which had grown out of his experience in working with the national editor of the *Journal of Geological Education*. In reply to a motion that the section take some action to expedite the circulation of this report, Dr. White reported it was scheduled for publication in the *Journal*.

Items of new business were the naming of John R. Coash as section representative to the national nominating committee, and the selection of a place for the 1958-59 meeting. Dr. Mahard extended an invitation to the section to meet at Denison University, Granville, Ohio, and the invitation was accepted.

Dr. Multer expressed the appreciation of the section for the fine arrangements which the Miami department had made for the meeting and President Martin thanked his colleagues at Miami for their help in making the arrangements. Following a reminder of the field trip on Saturday morning and the slide symposium to immediately follow the business meeting, the meeting was adjourned.

Saturday morning the group was transported by bus as guests of the Miami Department of Geology to see the Richmond section in the vicinity of Oxford and also some localities of interest in the Pleistocene geology of the area. After a noontime box lunch, several short stops were made and the party returned to Oxford where it disbanded.

Respectfully submitted,
LOIS J. CAMPBELL
Secretary

SOUTHEASTERN SECTION

No formal meeting of the Southeastern Section has yet been held in 1958. A list of the officers will be found on the inside of the back cover of this issue of the JOURNAL.

PACIFIC NORTHWEST

The annual meeting for business of the Pacific Northwest Section was held December 27, 1957, at the Davenport Hotel, Spokane, Washington. This meeting con-

Continued on page 27

THE ASSOCIATION OF GEOLOGY TEACHERS was founded in the Middle West in May, 1938. In November, 1951, it was organized as a national association, under which there are at present seven organized regional sections: Central, East Central, Eastern, New England, Far Western, Southeastern, and Pacific Northwest. An annual meeting of the national association is normally held in the fall, and sectional meetings are held in the spring.

The purpose of the Association, as stated in its Constitution, is "to foster improvement in the teaching of the earth sciences at all levels of formal and informal instruction, to emphasize the cultural significance of the earth sciences, and to disseminate knowledge in this field to the general public."

Anyone concerned with geological education, formal or informal and at any age level, is invited to apply for membership. *Inquiries should be addressed to the national secretary,* FREEMAN FOOTE, Williams College Williamstown, Massachusetts.

NATIONAL OFFICERS, 1958

President: CHILTON E. PROUTY, *Michigan State University*
Vice President: MILTON T. HEALD, *West Virginia University*
Secretary: FREEMAN FOOTE, *Williams College*
Treasurer: JAMES C. BRICE, *Washington University* (St. Louis)
Editor: MILDRED F. MARPLE, *The Ohio State University*
Editorial Committee: The National editor and treasurer and the section editors

CENTRAL

Pres.: DONALD C. BOARDMAN
Wheaton College
Vice Pres.: OLIVER R. GRAWE
Missouri School of Mines
Secr.-Treas.: DOROTHY J. GORE
The Principia College

EASTERN

Pres.: J. DONALD RYAN
Lehigh University
Vice Pres.: LINCOLN DRYDEN
Bryn Mawr College
Secr.-Treas.: MAURICE B. ROSALSKY
City College of New York

FAR WESTERN

Pres.: ROBERT M. NORRIS
University of California, Santa Barbara
Vice Pres.: NORMAN DOLLOFF
San Jose State College
Secr.-Treas.: FREDERICK C. GROS
University of Redlands
Editor: A. O. WOODFORD
Pomona College

EAST CENTRAL

Pres.: RAYMOND C. GUTSCHICK
University of Notre Dame
Vice Pres.: LOIS J. CAMPBELL
University of Kentucky
Secr.-Treas.: C. L. BIEBER
Depauw University
Editor: SIDNEY E. WHITE
The Ohio State University

NEW ENGLAND

Pres.: ALONZO W. QUINN
Brown University
Vice Pres.: GLENN W. STEWART
University of New Hampshire
Secr.-Treas.: MARSHALL SCHALK
Smith College

SOUTHEASTERN

Pres.: W. E. BERRY
Duke University
Vice Pres.: WILLIAM R. HIGGS
Louisiana Polytechnic Institute
Secr.-Treas.: CASPAR RAPPENECKER
University of Florida

PACIFIC NORTHWEST

Pres.: NORMAN R. ANDERSON
College of Puget Sound
Vice Pres.: W. FRANK SCOTT
State College of Washington
Secr.-Treas.: EDWARD P. THATCHER
University of Oregon